**A Dead Bone's Story - The Ecological, Biomechanical and Behavioral Approach to Assess Antler Weapon Design in Montana Elk

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Sexually selected weapons are morphological adaptations that arose from strong intrasexual selection and are commonly male biased. Sexual weapons are found across multiple phyla taking on various designs for male-male competition. While the benefits of large weapon sizes are well understood, relatively little is known about variation in weapon shape. The most common explanation for why weapons vary amongst species is changes in fighting styles. If animals experience major changes in habitat or if they change sufficiently in overall body size, then the ways that males encounter each other in a fight may change, resulting in new or different forces applied to the weapons. Extreme animal weapons, like elk antlers, push the boundaries of the possible. The largest males with antlers awkward and expensive help bulls win battles with rival males. The aim of my research is to use several approaches to understand what factors may influence elk antler design and male fighting behavior. I will (1) use field studies to describe intrasexual behaviors pre- and during rut to assess how males use these traits in contest and determine which portions of the antler perform as a signal or as tool; (2) 3D modeling and finite element analysis to rigorously model antler performance and relate specific components with a fighting or signaling function, (3) assess how different levels of harvest pressure across the state may influence fighting behavior and antler shapes, and lastly, (4) determine if the parasite, Toxoplasma gondii, influences male fighting behavior and antler development in Montana elk populations.